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THE PEA APHID IN MAINE

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BULLETIN 337

THE PEA APHID IN MAINE¹ ² W.

By EDITH M. PATCH

It is stated by a company who have been canning peas in Maine that the yields for the past four years have been as follows:

85	cases	of	peas	to	the	acre	in	1923
85	"	"	"	"	"	"	"	1924
100	"	"	"	"	"	"	"	1925
27	"	"	"	"	"	"	"	1926

The misfortune of 1926 is laid to unfavorable weather conditions and an infestation by pea aphids of such proportions that it might be characterized as an aphid plague. A representative of the packing company just quoted makes the comment "I am far from believing that the experience of this year spells the end of the pea business in the State of Maine. It naturally will put a crimp in it for a while; but, with injury only one year in four, the record is not too bad."

However if a prediction of future devastations of the pea crop by aphids were to be based on past records, the outlook for so bad a season in our locality would not be so often as one year in four. On the basis of past performance, one whelming infestation in 25 years would be nearer the schedule of expectation for northern New England.

The first appearance of pea aphids in excessive abundance in Maine was in 1899, a circumstance mentioned by Harvey (*II*).³ There has not been another attack so widespread until that of 1926. This statement should not be interpreted to indicate an absence of pea aphids in Maine for more than 25 years, for during certain years in certain localities they have infested the pea vines heavily and it is probable that some damage has been caused by them each year.

¹*Illinoia pisi* (Kaltenbach).

²Papers from the Maine Agricultural Experiment Station: Entomology No. 121.

³Reference is made by number (*italic*) to "Literature cited," p. 20.

In order to assume the proportions of a plague which might seem a threat against pea growing for market or cannery, the aphids need a rather elaborate stage setting. The previous summer should be favorable to aphid health and increase on late peas for the development of migrants which make their way to clover. The clover should be in a thrifty condition during the fall to support the aphids up to the time of egg-laying. The winter should be such as to incur a low percentage of mortality to the eggs. Spring conditions should be favorable both to clover growth and aphid development. In order for maximum damage, the peas should be late enough so that the height of aphid infestation will come about the time the pods are forming.

Even if weather conditions and the succession of neighboring pea and clover growth were annually most favorable to aphid development, there would not be a constant abundance of aphids. An over-crowding population invites disaster to the population itself. Aphids present in excessive numbers serve as a centre of attraction for their natural enemies, a discussion of which is given in another place in this bulletin. So many factors, indeed, work against a continuous heavy infestation by aphids during successive years in any given locality, that pea growers need not fear a frequent recurrence of so unfavorable a season as 1926.

The visitation by the pea aphid, mentioned previously as occurring more than 25 years ago, was not confined to Maine. This pest appeared in what were then the principal pea-growing regions of this country. "It was, in fact, one of the most important of all insects that ravaged crops in the United States during the seasons of 1899 and 1900" as recorded by Chittenden (4, p. 1) who further stated (4, p. 3):

"This pea louse during the first season of its abundance overran and laid waste fields of peas from Nova Scotia and Maine to Virginia and Maryland, in the last as well as in some neighboring States destroying about 50 per cent of the annual output and doing similar injury the following year, in spite of the vigorous efforts that were made to control it.

"An estimate of the total loss for the year 1899 along the Atlantic Coast States reached the sum of \$3,000,000. During 1900 the loss over the same area was placed as early as June 15 at \$4,000,000. Several cases of severe damage were reported in Maryland, in which 80 or more per cent of the peas on farms of 500 or 600 acres were completely destroyed. In short, the pea growers of the Atlantic region and westward as far as Wisconsin suffered very severe losses, which gave rise to the expression that this country had been visited by a veritable scourge."

In 1909 the same writer (5, p. 3) observed "At intervals since 1901 this species has been injurious locally but there have been no widespread outbreaks."

In the same connection, the past history of this aphid in Connecticut is significant. Britton (1, p. 276) reported "The green pea louse was considerably less abundant (in 1901) than in 1900 and 1899"; and later the same writer stated (2, p. 212) "It has been on the decrease since 1900, and while late peas may be injured in some cases, in others it has not been found necessary to apply any remedial treatment." A recent report by the same entomologist (3, p. 226) reads, in part, "The pea aphid was present in many fields, but on the whole it did not cause serious injury to peas in Connecticut in 1925."

The several foregoing quotations show that great losses due to the pea aphid during one or two years in certain localities are no cause for the alarmed prediction that such severe losses are to be expected annually. Thus there seems precedent enough for the optimism of the Maine canner who does not let one disastrous season discourage him.

Farther south in parts of the country where there are two crops of peas each year, there are localities where, because of "the uncertainty of bringing their crops to maturity without their suffering such damage by the aphides as to render them unprofitable, many truckers have stopped trying to grow garden peas for the market," as reported of Tidewater Virginia (17, p. 32); but such disastrous conditions have not prevailed in New England.

SEASONAL HISTORY

In the north, where the winters are as severe as in Maine, the pea aphid over-winters only in the egg stage. The eggs, which are deposited on red clover (*Trifolium pratense* Linn.)⁴ hatch in the spring and the first generation aphids are wingless. These are called the stem-mothers because they are the first of a series of generations of females which successively appear during the summer months. Part of the summer females are wingless and part of them are winged. The earlier of the winged females (which may

⁴In the northern range of crimson clover (*T. incarnatum* Linn.) pea aphids also deposit eggs on this plant. Alfalfa (*Medicago sativa* Linn.) serves this insect in the same capacity (7, p. 11).

be termed the spring migrants) leave the red clover for more succulent plants belonging to the same family. Where peas are available, these constitute a favorite vegetation for summer colonization. During the time when feeding conditions on the peas are favorable, the colonies of aphids are for the most part wingless. When the pea vines have passed their prime, a greater proportion of winged aphids are developed and these fly to more tempting members of the Pulse Family. Where red clover is present and thrifty, this vegetation is sought by the winged females (which may be termed the fall migrants).

Late in the season, wingless females develop that differ structurally from the wingless females that have appeared in the previous generations. They differ also in the circumstance that they mate with male aphids and deposit eggs instead of giving birth to active young. The males may be winged or wingless and they appear only late in the season, being cotemporary with the egg-laying females.

Field observations of the pea aphid were made by the writer during 1926 and the oviparous females were found on red clover during October. On October 8, in the vicinity of Newport, Maine, fewer than one-tenth of these last generation females were mature, the others being but partly grown. As aphid development is comparatively slow during low temperature, it will become evident that in Maine a large majority of the oviparous females are not ready to deposit eggs until after the season of frosts. Such of these eggs as safely live through the winter are the source of the stem-mothers, the first spring generation in the annual cycle.

A species of aphid which uses one type of vegetation for the site of its eggs and another type (either exclusively or by preference) for its summer colonies, is usually called a migratory aphid. There seems no real inconsistency in applying this term to the pea aphid in the north where it annually migrates between a primary host, the clover, and a secondary host, the pea or other succulent legume.

The plants which most migratory aphids seek for their summer colonies are not closely related botanically to their over-wintering hosts. In this respect the pea aphid is an exception in that its primary and secondary hosts belong to the same family of plants; but this does not alter the fact of its normal annual migrations away from, and back to, an over-wintering host.

Attention is frequently called to the circumstance that summer colonies of the pea aphid, under favorable conditions, may be found on red and crimson clovers, a fact that seems to discredit the migratory habits of this insect. However, it is not uncommon for migratory aphids belonging to the same tribe (Aphidini) as the pea aphid to establish summer colonies on their primary food plants provided such plants are in as succulent and thrifty condition as those normally used for summer residence.⁵

Such is the seasonal history of the pea aphid in the north where it over-winters only in the egg stage.

"In the latitude of La Fayette, Ind., the species winters both as living viviparous females, usually wingless, and as eggs.....while farther south, in the latitude of Tennessee, the sexual forms which lay the overwintering eggs are rare, the insect ordinarily passing the winter as living plant-lice, both wingless and winged forms being able to withstand the lower temperatures in that latitude. Still farther south we know only the viviparous females and our observations lead us to believe that the species may reproduce viviparously indefinitely in localities where the winters are quite mild." (7, p. 26).

RECOGNITION MARKS OF THE PEA APHID

Inasmuch as this insect is the only large green aphid which is likely to occur in great numbers on the tender terminal parts of pea vines, there is slight danger of mistaking its identity when present in such situations. Its general appearance is so much like that of the potato aphid (*Illinoia solanifolii* Ashmead.) that were the food preferences of the two species the same, there would be difficulty in distinguishing them in the field. Further reference to this subject is made in the paragraphs under "Food Plants" on page 14 of this bulletin. However, there is no excuse for confusion by anyone who has facilities for microscopic examination. The cornicles (the two tubes near the tip of the body) are notice-

⁵The bean aphid (*Aphis rumicis* Fab.) may be reared through the summer on the spindle tree (*Euonymus*) if provided with a succession of new shoots due to pruning back the old growth and stimulating the new. Similarly, summer colonies of the potato aphid (*Illinoia solanifolii* Ashmead) may be maintained on rose bushes if they have access to tender, rapidly growing, new stalks. If a buckthorn hedge is pruned, the resulting new growth is liable to infestation by spring migrants of the buckthorn aphid (*Aphis abbreviata* Patch) in the same way that the usual secondary food plants are colonized.

ably more slender than those of the potato aphid, and their tips lack reticulation. (Figure 3). This difference in the cornicle tips holds good for the mature individuals in all the various generations of both species. There are other identification marks apparent to one familiar with these insects; but the characters of the cornicles alone are sufficient for distinguishing the pea aphid from the potato aphid.

The mature viviparous females are about one-eighth of an inch long, their size varying with the character of the food supply; while the males and the oviparous females are considerably smaller.

The general body color of the wingless forms is pea green, often with a very slight deposit of waxy powder on the abdomen. The tips and the joints of the appendages are brown to blackish. The thorax, in the winged forms, is yellowish green or brown, depending on the age of the individual.

MAINE FOOD PLANTS OF THE PEA APHID

As has been stated elsewhere in this bulletin, the pea aphid is primarily concerned with various plants of the Pulse Family. The only authentic exception known to the writer is shepherd's purse, on which successive generations of the pea aphid have been experimentally reared (12, p. 88), (17, p. 35). The large green aphid most commonly found on shepherd's purse is the potato aphid; but where this weed is in fresh condition near over-crowded pea vines, it is subject to colonization by the pea aphids. While the shepherd's purse is never a first choice, it serves, in the absence of more acceptable vegetation, to tide over the pea aphids for one to several generations. This was true in heavily infested localities in Maine in 1926. The writer has found the following plants of the Pulse Family colonized by pea aphids in Maine: Alfalfa (*Medicago sativa*); Alsike, Low Hop, Rabbit-foot, Red, White, and Yellow Clover (*Trifolium hybridum*, *T. procumbens*, *T. arvense*, *T. pratense*, *T. repens*, *T. agrarium*); Beach and Sweet Pea (*Lathyrus maritimus*, *L. odoratus*); Common, Cow, and Spring Vetch (*Vicia angustifolia*, *V. Cracca*, *V. sativa*). This is doubtless still incomplete even as a Maine list. Fuller lists for other localities are given by Davis (7, p. 9) and by Smith (17, p. 33).

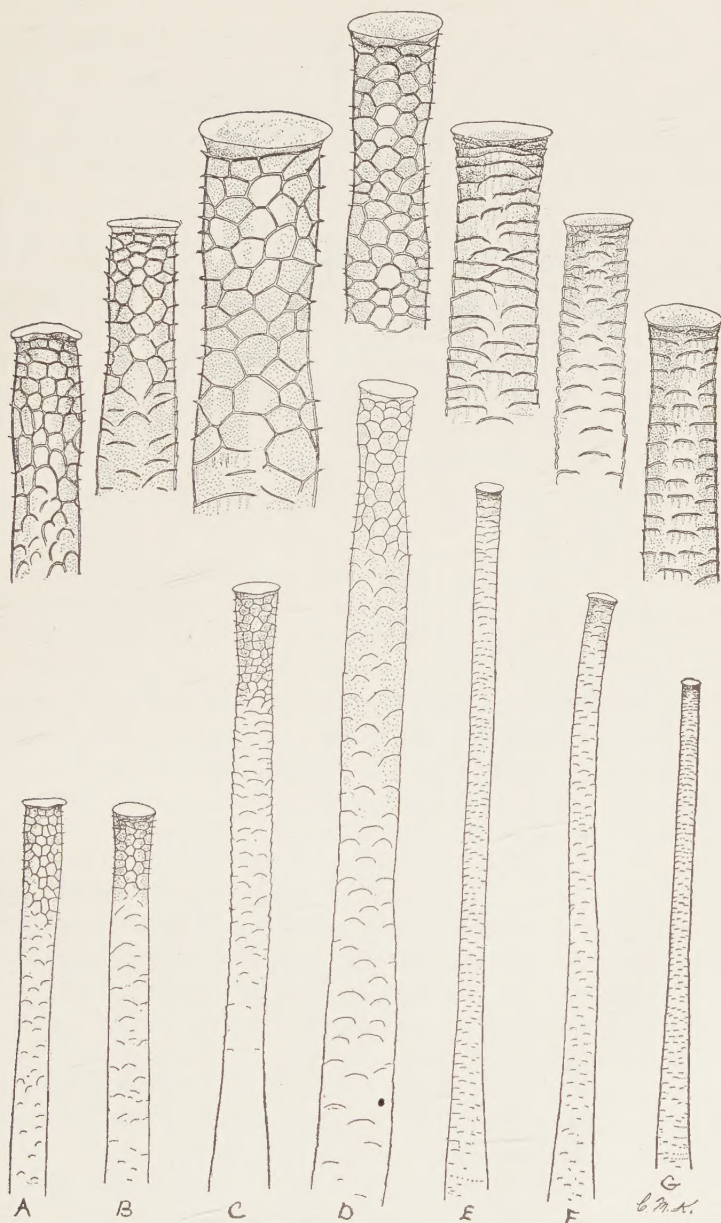


FIG. 3. A-D, Cornicles of potato aphids, enlarged, and tip of same showing reticulation. A, male; B, oviparous female; C, winged viviparous female; D, wingless viviparous female. E-G, Cornicles of pea aphids. E, wingless viviparous female; F, G, winged viviparous females.

THE PEA APHID AS A CARRIER OF PLANT DISEASE

The direct damage done by the aphids in feeding on the plants they colonize is not always the total of the injury they inflict. Indirectly they may cause harm by carrying disease from sick to healthy plants.

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"Red-clover mosaic has been transmitted to the garden pea and sweet pea by artificial inoculations and to the garden pea by means of aphids. Inoculations by means of aphids also have indicated that red clover is susceptible to the mosaic occurring on these two hosts.

"Since the red clover is a perennial on which the pea aphid is said to overwinter, it is probable that the aphids migrating from clover to peas in the spring act as carriers of the disease and thus introduce mosaic into the fields." (8, p. 771.)

NATURAL CONTROLS

Nothing lives, or dies, by an independent schedule. Even so small a creature as a pea aphid forms one link in an endless chain of events which are influenced by its welfare or its disaster.

Unfavorable weather, either directly or indirectly by way of affecting its food plants, may retard what threatened to be a heavy infestation of pea aphids. In turn, a corresponding food shortage is experienced by aphid-eating animals, so that certain birds and certain insects such as lady beetles, syrphid maggots and aphid-lions, stimulated by hunger, seek the more eagerly for what aphids there are, thus reducing the supply of these insects to a minimum or, in some localities perhaps annihilating them altogether. Associated with these events is the circumstance that such predaceous enemies as lady beetles and syrphid maggots and aphid-lions may die of starvation, or, if reaching maturity themselves, their young may not find food enough to sustain them. We then have an area in which these insect-enemies of the pea aphids are wanting, a situation which cannot change until conditions are again favorable for such an aphid infestation as will invite the predaceous insects to come from neighboring areas where they may be present.

Or we may start the story at a time when, as in 1926, an aphid tide is at its flood. The colonies of these insects crowd one another. One pea vine, heavy with its unnatural burden, trails across another in the same plight. The stage is set for contagious or epidemic disease. Perhaps some of the aphids sicken with fungus

disease at a time when weather conditions are favorable to the spread and development of fungus spores. Within a few days the aphid tide may reach its ebb and on the vines may be found none but dead and dying insects.

Or a minute parasitic wasp may appear and busy itself stinging the bodies of the aphids, leaving an egg at each puncture. The plump body of an aphid contains enough food for the young larva hatching from the egg to attain its entire growth from footless grub to winged insect. When developed, the tiny wasp bites its way through the stiff skin of the now dead aphid and starts its search for other aphids, flying from one to another and leaving an egg in each of its many victims.

Thus we have on the one hand the aphids, capable of rapid development and reproduction⁶; and on the other hand predaceous and parasitic enemies and disease with inter-related increase and decrease; and over the whole situation the weather plays its part for better or for worse.

REMEDIAL AND PREVENTIVE MEASURES

Though, fortunately, natural controls⁷ keep pea aphids within bounds that it would be impossible for man alone to attain, it is not to be expected that man can invite these insects by continuously growing large areas of clover and peas in juxtaposition without assuming responsibility and expense.

Under Maine conditions three plans of attack are possible and, in certain cases, practical. These may be indicated as mechanical control, insecticides, and cultural methods.

Mechanical control: Brushing the aphids from the vines into containers from which they can be emptied and destroyed is possible on a large scale. This is accomplished by means of a machine

⁶The average age at which females began reproducing.....was 12.5 days after birth.....The average length of life of viviparous females was 31.7 days.....The average number of young given birth per female was 80.7, (17, p. 58, 60).

⁷"On red clover I have seen this aphid multiply in spring until its numbers threatened the life of the plant, and then disappear, practically, thru natural agencies; this for five successive seasons.....Were it not for these influences the louse would become a pest of the first magnitude in spite of the vigor of the clover plant. Occasionally and locally it does become such a pest." (9, p. 154).

called an aphidozer. Aphidozers have been used by Maine growers whose experience indicates that these machines can be used without injury to the vines only early in the season. This experience is in accordance with experimental work in certain other parts of the country where the aphidozer has been found of value if the aphid infestation occurs at a time when the vines are small and the aphid colonies are mostly on the tips and upper small leaves of the plants. It may not be possible to make a satisfactory collection of the aphids by the machine if the crop has grown to the point where the pods contain small peas. Whether the aphidozer can be perfected so as to collect aphids from more mature vines without undue injury is still a matter of experimentation.

"By using a new device called the aphidozer, experimental workers and pea canners were successful in materially reducing the losses caused by the pea louse in certain fields during the year. This machine, first worked out by J. E. Dudley and E. M. Searls of the United States Department of Agriculture working in cooperation with the Department of Economic Entomology, has been pronounced a success by canners who have tried it on their fields.

"While some work was done on this apparatus in Wisconsin during 1923, the machine was completely rebuilt in the spring of 1924. New features, such as a positive chain drive, brushes on the reel and a heavy galvanized iron bottom for holding the aphids, were some of the new additions that helped to make the machine practical for general field use. From its success during the past year, it appears that this apparatus will become one of importance to Wisconsin pea growers.

".....Experimental work shows that the machine sweeps from 80 to 90 per cent of the aphids from the vines. An average of 18.38 pounds per acre were collected from 41½ acres in the experimental fields. This brought about a marked reduction in the number of aphids with consequent increase of the yield of the crop.....

"In spite of the fact that the past season was not entirely favorable for a study of this project, because cool weather delayed the development of the aphids and allowed the peas to make unusually vigorous growth, it is apparent that the mechanical means of removing the insects from the vines is more promising than any of the other control methods so far developed. It was noted in the trials that the damage done to the crop by running the machine through the field was very slight. By running it counter clockwise, which is opposite to the direction in which the mower is run to cut the crop, any lodging that may be produced will not interfere seriously with harvesting. The fact that the yield in the experimental plots was increased from 20 to 107 per cent over the check plot is a distinct recommendation for the further development of the process.

"It appears that there are several ways in which the enemies of the pea louse which are gathered in the aphidozer can be liberated and permitted to

continue their work in the field. One method is by floating off the pea aphids with cold water and returning the uninjured parasites to the field. Another lies in the fact that when the pea lice are collected in the aphidozer, they die very quickly and can soon be scattered over the fields without further damage. In this way the parasites which live upon this insect can again be distributed to continue their helpful work." (14)

Insecticides: Of the various sprays and dusts which have been used experimentally in pea aphid control, one of the most satisfactory has been nicotine dust. The development of a self-mixing duster has enabled the grower to reduce the cost of the application of nicotine dust. For general purposes a dust containing 3% of nicotine, with a hydrated lime carrier, has proven most satisfactory, although other carriers such as sulphur and gypsum have given good results. In order to obtain good control more than one application is often needed; and the chief drawback to the use of nicotine dust here in the East, in fields where the crop is grown for the cannery, is the expense involved. In the home garden it is perhaps the best remedy.

Cultural Methods: Pea growers, by planting large areas of the favorite food of the pea aphids, invite the visitation of these pests. Are there methods by which such visits can be prevented? Because cultural methods look to prevention, rather than cure, they are less spectacular than other types of control. As has been stated, the pea aphids in Maine pass the winter in the egg stage on red clover. Where feasible, therefore, it would seem desirable not to grow peas and clover in neighboring fields. If clover, grown for "green manure," is found to be infested by pea aphids in the spring, plowing it under before the aphids move over to the peas would, under certain conditions, be good practice. A late plowing under of clover in the fall after the aphids have returned to lay their eggs would often be a possible part of a program in crop rotation.

The practice of burning over fields containing clover in the early spring or late fall would insure the destruction of pea aphids or their overwintering eggs. Any method, in fact, that would prevent or make difficult the passage of pea aphids from clover to pea fields is worth considering as an agricultural practice.

Certain varieties of peas are reported to be less attractive to aphids than others. Comparative tests of different varieties with this in mind might advantageously be undertaken by growers.

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Of the precautionary measures perhaps none is more important for the grower of Maine peas for the cannery than a good proportion of early pea seed and early planting. Weather permitting, such practice insures the development of pea vines past the stage most susceptible to damage previous to the time of colonization of the vines by the aphids.

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